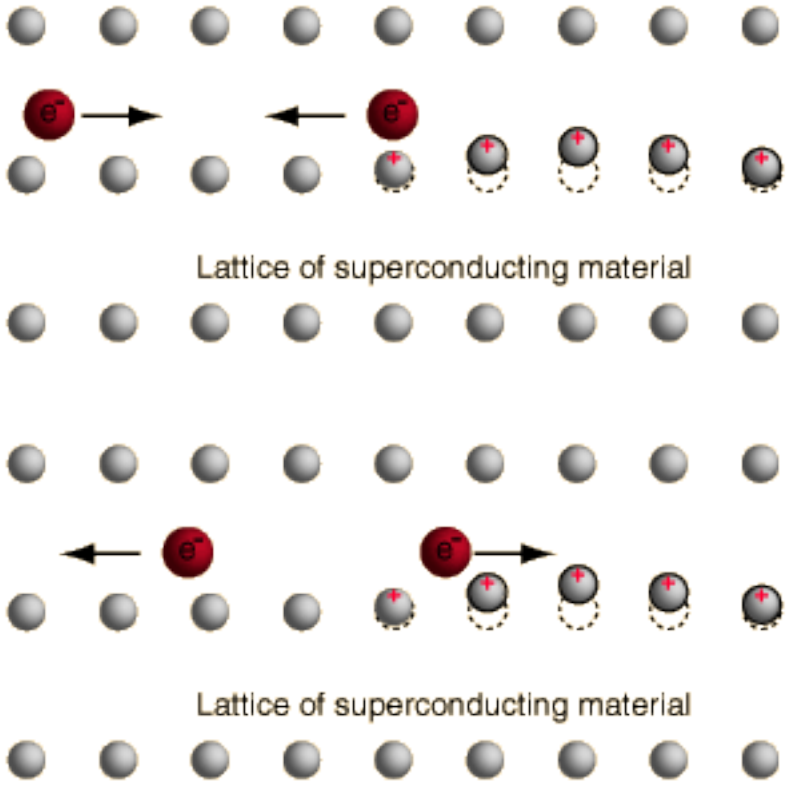
BCS Pairing

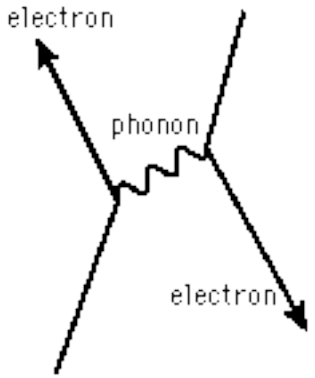
BCS theory of superconductivity was proposed by Bardeen, Cooper, and Schrieffer ("BCS") in 1957 (Nobel Prize in 1972).



http://hyperphysics.phy-astr.gsu.edu/hbase/solids/coop.html

A passing electron attracts the lattice, causing a slight ripple toward its path

Another electron passing in the opposite direction is attracted to that displacement



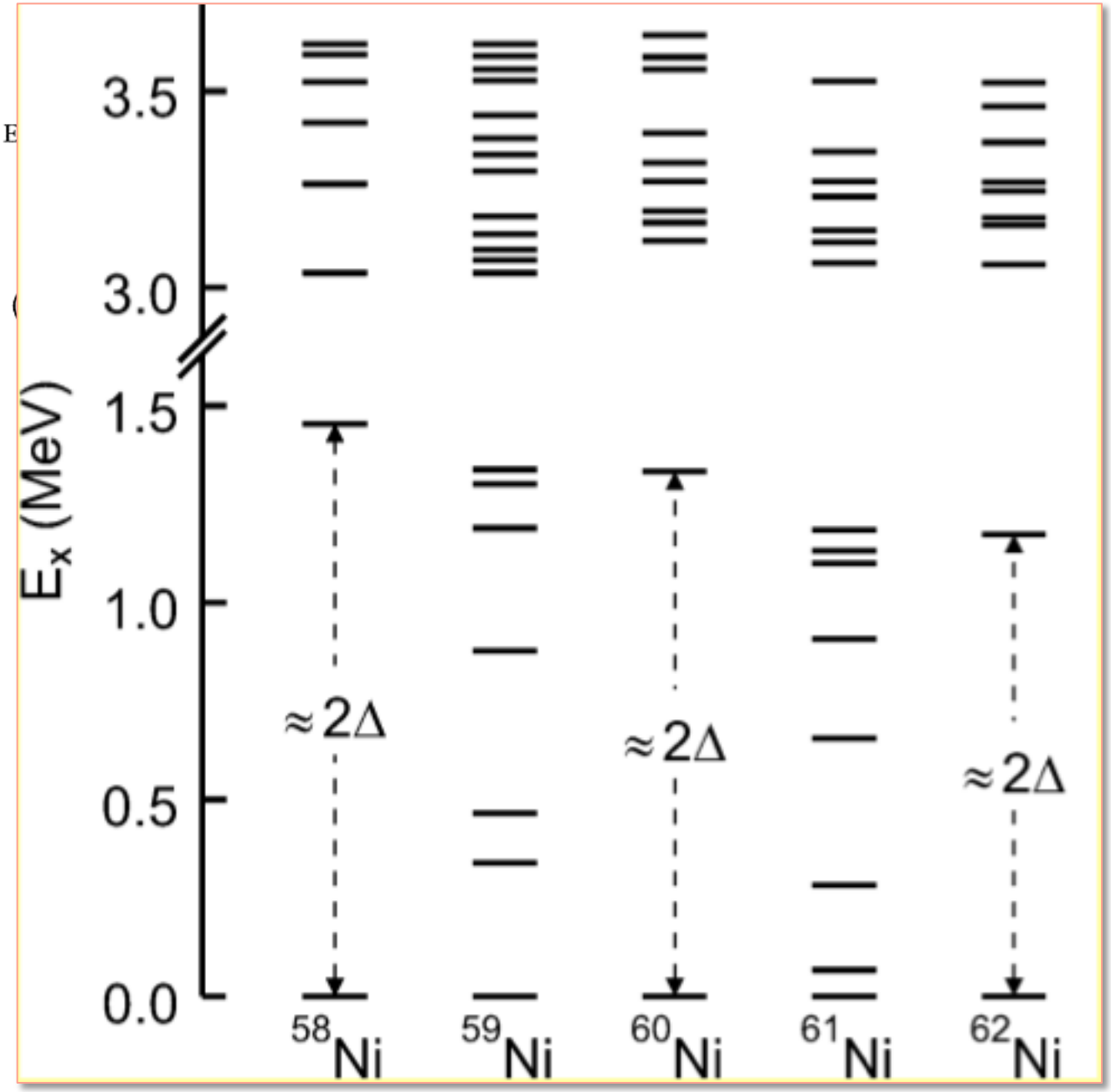
Cooper pair

Energies of first excited states: even-even vs. odd-A nuclei

FIG. 1. Energies of first excited intrinsic states in deformed nuclei, as a function of the mass number. The experimental data may be found in *Nuclear Data Cards* [National Research Council, Washington, D. C.] and detailed references will be contained in reference 1 above. The solid line gives the energy $\delta/2$ given by Eq. (1), and represents the average distance between intrinsic levels in the odd-A nuclei (see reference 1).

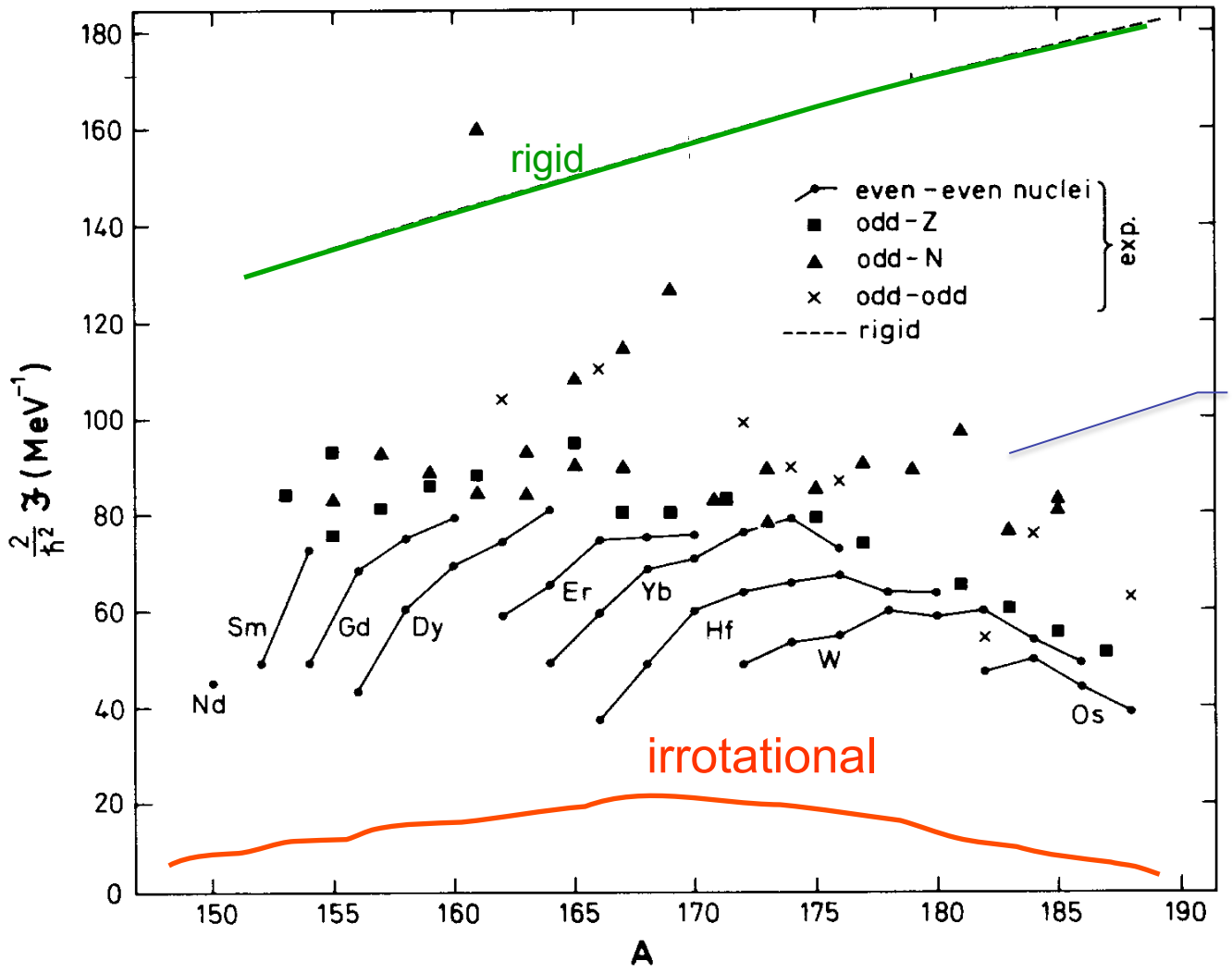
The figure contains all the available data for nuclei with $150<A<190$ and $228<A$. In these regions the nuclei are known to possess nonspherical equilibrium shapes, as evidenced especially by the occurrence of rotational spectra (see, e.g., reference 2). One other such region has also been identified around $A=25$; in this latter region the available data on odd-A nuclei is still represented by Eq. (1), while the intrinsic excitations in the even-even nuclei in this region do not occur below 4 Mev.

We have not included in the figure the low lying $K=0$ states found in even-even nuclei around Ra and Th. These states appear to represent a collective odd-parity oscillation.



Ground-state nuclear moments of inertia

Reduction of moment of inertia due to BCS pairing. Migdal (59)



well reproduced by cranked HFB calculations

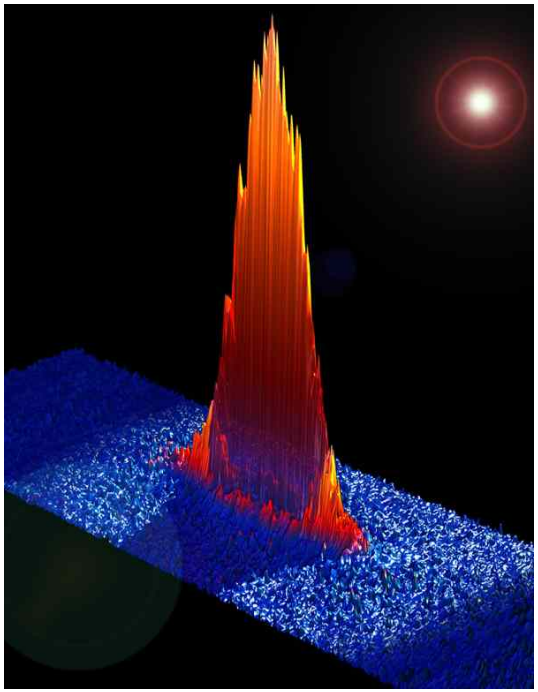
Nuclear moments of inertia at T=0 lie between the superfluid and normal limits

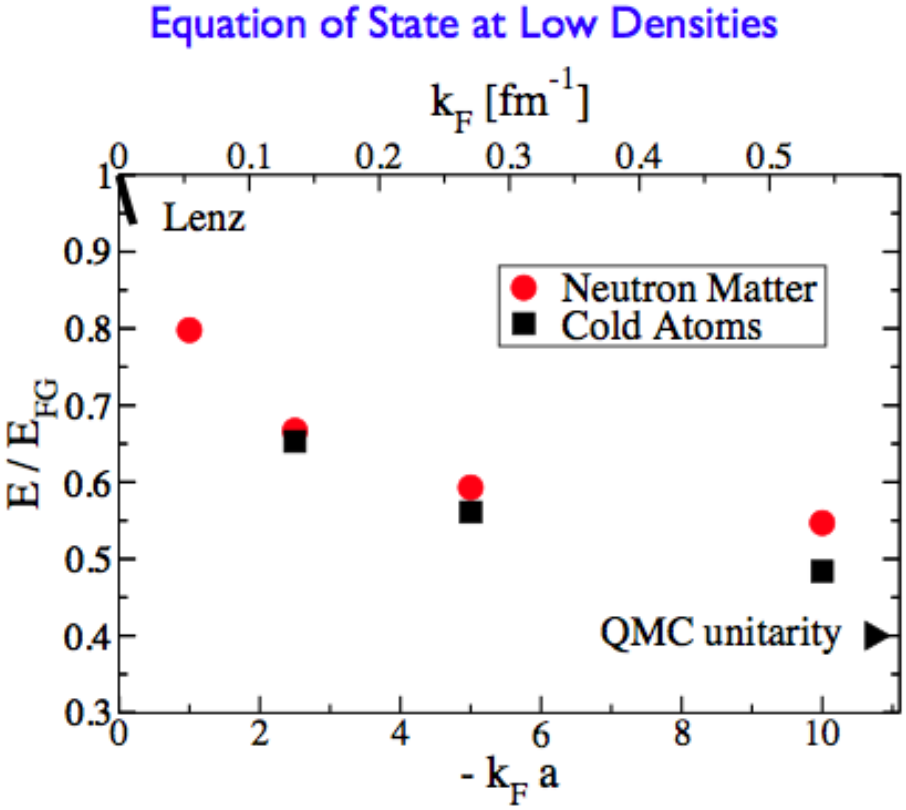
Low-density regime of neutron EOS

Dilute fermion matter:

- **strongly correlated (pairing)**
- **very large scattering length (unitary limit)**

- Low-density neutron matter
- Cold fermions in traps





Gezerlis and Carlson, Phys. Rev. C 77, 032801(R) (2008)

- Connections to nucleonic pairing in nuclei and neutron stars
- Connections to color superconductivity in quark matter